PART I - ADMINISTRATIVE

Section 1. General administrative information

Title of project

Kootenai River Fisheries Recovery Investigations

BPA project number: 8806500
Contract renewal date (mm/yyyy): ☐ **Multiple actions?**

Business name of agency, institution or organization requesting funding
Idaho Department of Fish and Game

Business acronym (if appropriate) IDFG

Proposal contact person or principal investigator:

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NPPC Program Measure Number(s) which this project addresses
10.4B;.1;.2;.3;.4;.5; and 10.6C.1

FWS/NMFS Biological Opinion Number(s) which this project addresses
ND-USFWS BO Incidental take

Other planning document references
Kootenai River White Sturgeon Recovery Plan, State of Idaho Bull Trout Recovery Plan

Short description
Determine status of Kootenai River white sturgeon (ESA), burbot (a genetically distinct stock), whitefish, and bull and rainbow trout stocks in the Kootenai River and effects of water fluctuations and ecosystem changes on these stocks.

Target species
Kootenai River white sturgeon, burbot, redband rainbow and bull trout, and mountain whitefish

Section 2. Sorting and evaluation

Subbasin
Upper Columbia – Kootenai River

Evaluation Process Sort

CBFWA caucus	Special evaluation process	ISRP project type
Mark one or more caucus	If your project fits either of these processes, mark one or both	Mark one or more categories
☐ Anadromous fish ☒ Resident fish ☐ Wildlife	☒ Multi-year (milestone-based evaluation) ☐ Watershed project evaluation	☐ Watershed councils/model watersheds ☐ Information dissemination ☐ Operation & maintenance ☐ New construction ☒ Research & monitoring ☐ Implementation & management ☐ Wildlife habitat acquisitions

Section 3. Relationships to other Bonneville projects

Umbrella / sub-proposal relationships. List umbrella project first.

Project #	Project title/description

Other dependent or critically-related projects

Project #	Project title/description	Nature of relationship
8346700	Libby Reservoir levels/Kootenai River IFIM.	Recovery of Kootenai River white sturgeon is dependent on augmented spring flows for sturgeon spawning and rearing. Winter low flows to test limitations to burbot migrations are dependent on water management from Libby.
8806400	Kootenai River white sturgeon study and experimental culture.	IDFG is a cooperator with the Kootenai Tribe of Idaho (KTOI). IDFG assists the tribe in the capture of brood fish for their hatchery and evaluates the hatchery contribution to the population, interaction between juvenile wild/hatchery sturgeon.

9404900	Kootenai River ecosystem improvement study.	IDFG is a partner in the Adaptive Ecosystem Assessment method (AEA) with the Kootenai Tribe. IDFG has been a participant in the AEA process and has helped fund the associated workshops and a user guide to the computer program.

Section 4. Objectives, tasks and schedules

Past accomplishments

Year	Accomplishment	Met biological objectives?
1995	Hypothesis developed infering river flow impair burbot spawning migrations and fitness.	Incomplete - hypothesis testing is underway
1997	Burbot in Kootenai River and Kootenay Lake genetically distinct from burbot above Kootenai Falls in Montana.	Yes
1997	Kootenai River white sturgeon spawning migration behavior and environmental variables modeled.	Yes – model will be used to predict sturgeon response to regulated flows and temperature.
1998	Rainbow trout spawners in Deep Creek (major tributary to Kootenai River in Idaho) are adfluvial stock and juveniles seed lower river in Idaho and Kootenay Lake, B.C.	Yes
1998	Seismic studies of the Kootenai River subbottom indicates 5 m of coarse sand, no evidence of gravels or cobbles.	Yes – no evidence that sand has superimposed sturgeon spawning gravels since operation of Libby Dam.

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Determine if growth, condition, and Wr of adult white sturgeon in the Kootenai River are effected by operational changes in Libby Dam	a	Collect a sample of 50 adult sturgeon, measure, weigh, sex, determine maturity, collect fin ray, tag, and release.
		b	Calculate growth, condition, and Wr each year and evaluate with hydrologic and temperature data.

2	Determine the minimum flow that will provide spawning and rearing habitat for Kootenai River white sturgeon and bring off a successful year class.	a	Tag 12 mature white sturgeon with sonic and radio transmitters.
		b	Determine response of adult sturgeon to flows in river provided from Libby Dam by radio and sonic telemetry.
		c	Measure physical parameters of habitats utilized by adults: temp., flow, depth, substrate etc.
		d	Measure egg deposition with egg sampling mats, numbers, date, location, egg stage, substrate, velocity, depth, and temperature. Stage each egg to determine spawn date and record number of spawning events.
		e	Measure larval relative abundance with D-rings, half meter nets, benthic trawls, and meter nets.
		f	Measure fingerling and juvenile abundance with gill nets, collect lengths, weights, and fin rays. Age finrays and compare year class strength to hydrologic conditions.
		g	Quantify early life history white sturgeon habitat and prepare habitat suitability index (HIS) curves and compare to hydrologic conditions and HIS curves for Columbia River white sturgeon.
3	Determine if food abundance is a factor limiting juvenile white sturgeon growth and condition.	a	Collect 25 juvenile hatchery white sturgeon, measure, weigh, and collect stomachs. Examine stomach contents, number and weight of items.
		b	Calculate condition, growth rates, and Wr of juvenile wild and hatchery sturgeon and compare changes in these factors and stocking numbers and densities of hatchery fish.
		c	Calculate electivity index and determine food preferences to what

			is available (benthic data collected by KITI) and if limiting.
4	Determine if growth and survival of juvenile white sturgeon has been limited by varying flows post dam.	a	Capture hatchery and wild juvenile white sturgeon; measure, weigh, collect fin ray sections, and calculate Wr and condition.
		b	Compare annual growth rates to hydrologic conditions including power peaking, temperature, food abundance (data collected by KTOI), and operations of Libby Dam.
5	Determine if high flows during winter block or delay the migration of spawning burbot.	a	Capture adult burbot with hoopnets and implant a minimum of eight sonic and four radio transmitters.
		b	Conduct routine sonic and radio telemetry on burbot during various discharge regimes.
		c	One five week block of low flow (6,000 cfs) may be provided by the USACE to test movements of burbot. Use Fishery Exact test and Chi-square to determine statistical relation of movement and discharge.
		d	Evaluate spawning success with half meter nets and D-rings.
		e	Deploy continuous recording thermographs in major spawning tributaries and compare temperature to timing of spawning.
		f	Monitor burbot migration into Idaho from lower river with hoopnets. Examine females for unspent eggs.
6	Identify a means of effectively sampling larval burbot and sturgeon.	a	Deploy drift nets (objective 5d)
		b	Experiment with mid-water trawl, bottom trawl, half-meter nets, meter nets, and other active and passive gears at prospective habitat locations in the Kootenai River and Kootenay Lake.
7	Determine the genetic level of similarity between burbot stocks in the Kootenai River and Duncan Lake (an impounded portion of a	a	Restriction fragment length polymorphisms will be used to determine the genetic similarity between the two stocks. Evaluate

	tributary to Kootenay Lake).		the feasibility of the Duncan stocks potential use for recovery of Kootenai River fish as a captive breeding wild population.
8	Determine source of rainbow and bull trout recruitment in Idaho portion of Kootenai River.	a	Trap outmigrating juvenile rainbow and bull trout in Boulder Creek with a screw trap.
		b	Locate marked juvenile outmigrant rainbow and bull trout in the Kootenai River with seine and electrofishing gear.
		c	Capture adult rainbow trout and mark with Floy reward tags. Implant 20 rainbow trout and four bull trout with radio transmitters and monitor movement .
		d	Conduct mark and recapture population estimates in selected reaches of the upper Kootenai River in Idaho.
		e	Determine movement, habitat use, and spawning locations of adult rainbow and bull trout through radio tracking.
		f	Calculate minimum exploitation of rainbow trout from return of reward tags. Return of tags will also provide information on repeat spawners and post spawn distribution of trout.
9	Determine if contaminants in the Kootenai River water and/or sediments are limiting survival of sturgeon eggs and larvae.	a	Determine contaminants to be tested.
		b	Remove 5 g sample of gonads from adult sturgeon and determine select contaminant levels.
		c	Determine primary mode of contaminant uptake in spawned white sturgeon eggs.
10	Determine if burbot will spawn under captive conditions in historic tributaries.	a	Obtain genetically and behaviorally similar donor stock of adult burbot (20 – 30 adults).
		b	Construct enclosure in Myrtle Creek and maintain captive brood stock under semi natural conditions.

		c	Examine brood fish post spawn to determine if they spawned under captive conditions.
11	Determine if and at what velocity spawning fitness or vitellogenesis of burbot is impaired.	a	Design a statistically valid study (with a Fish Physiologist) to determine stress levels in burbot.
		b	Under test and control laboratory conditions expose adult burbot to stress testing with various flow velocities.
		c	Measure blood cortisol levels and effects on vitellogenin synthesis to eggs.
		d	Identify whether or not and at what level velocities impose a stress factor to burbot spawning fitness.

Objective schedules and costs

Obj #	Start date mm/yyyy	End date mm/yyyy	Measureable biological objective(s)	Milestone	FY2000 Cost %
1	1/1998	12/2018	Recruitment of wild year classes restore population and the Kootenai River white sturgeon is delisted	x	10.00%
2	1/1995	12/2018	Recruitment of wild year classes restore sturgeon population	x	40.00%
3	1/1997	12/1999	Determine if food availability is a limiting factor	x	5.00%
4	1/1995	12/2018	Relation of Libby operations to white sturgeon condition and growth determined	x	5.00%
5	1/1996	12/2000	Hypothesis testing completed flow /burbot migration and stress factor relation identified.	x	8.00%
6	1/1998	12/2005	Systematic sampling design developed to measure year class success of burbot and sturgeon at age –0.	x	2.00%
7	1/1998	12/2000	Genetic analysis of	x	1.00%

			Duncan and Kootenai stocks completed and comparisons made to determine suitability of Duncan stock as donor.		
8	1/1997	12/2004	Population statistics, movement, exploitation, and recruitment source of rainbow and bull trout determined and management recommendations provided.	x	20.00%
9	1/1997	12/2000	Contaminant levels in sturgeon eggs determined and possible sublethal levels verified.	x	1.00%
10	1/2000	12/2003	Critical stress velocity for burbot and effects on vitellogenesis determined.	x	4.00%
11	1/2000	12/2006	Burbot donor stock spawn and progeny return to spawning tributary.	x	4.00%
				Total	100.00%

Schedule constraints
Endangered Secies Act is abandoned by Congress and support for sturgeon and bull trout recovery is impeded. USACE does not cooperate to fullest extent with winter test flows for burbot leading to inconclusive data and need to repeat testing next year.

Completion date
12/31/2018

Section 5. Budget

FY99 project budget (BPA obligated): $604,233

FY2000 budget by line item

Item	Note	% of total	FY2000
Personnel	4 permanent, 8-10 temporary part time	%33	202,198

Fringe benefits	Normal state benefits	%11	69,695
Supplies, materials, non-expendable property	Office and field supplies, electrofishing and lab gear	%6	34,519
Operations & maintenance	Boats, motors, trailers and trucks	%8	46,424
Capital acquisitions or improvements (e.g. land, buildings, major equip.)	Replacement boats, motors and electronic gear	%5	33,075
NEPA costs		%0	
Construction-related support		%0	
PIT tags	# of tags:	%0	
Travel	AFS meetings, special symposia, workshops	%4	23,732
Indirect costs		%16	101,003
Subcontractor	Canadian subcontract, professional statistical consulting, genetic analysis by University of Idaho	%17	105,950
Other		%0	
TOTAL BPA FY2000 BUDGET REQUEST			$616,596

Cost sharing

Organization	Item or service provided	% total project cost (incl. BPA)	Amount ($)
		%0	
		%0	
		%0	
		%0	
Total project cost (including BPA portion)			$616,596

Outyear costs

	FY2001	FY02	FY03	FY04
Total budget	$647,425	$679,800	$713,785	$749,480

Section 6. References

Watershed?	Reference
☐	Alekperov, A.P. 1996. An analysis of the population of the Kua sturgeon [Acipenser guldenstadti persicus Borodin] in relation to the disruption of migratory and spawning conditions. Journal of Ichthyology 9 (2): 297-300.
☐	Apperson, K. and P.J. Anders. 1991. Kootenai River white sturgeon investigations. Idaho Department of Fish and Game. Prepared for

	Bonneville Power Administration. Annual Progress Report, Project 88-65, Portland, Oregon
☐	Auer, N.A. 1996. Response of spawning lake sturgeon to changes in hydroelectric facility operation. Transactions of the American Fisheries Society 125:66-77
☐	Becker, G. 1983. Fishes of Wisconsin. The University of Wisconsin Press. Madison, Wisconsin
☐	Bonde, T.H. and R.M. Bush. 1975. Kootenai River water quality investigations, Libby Dam preimpoundment study 1967-1972. U.S. Army Corps of Engineers.
☐	Beer, K.E. 1981. Embryonic and larval development of white sturgeon (Acipenser transmontanus). Master's Thesis, University of California, Davis, California. 93 pp.
☐	Dowling, T.E., C. Moritz and J.D. Palmer. 1990. Nucleic acids II: restriction site analysis. In D.M. Hillis and C. Moritz (ed.) Molecular Systematics, Sinauer Associates, Inc., Sunderland.
☐	Jones, D.R., J.W. Kiceniuk, and O.S. Bamford. 1974. Evaluation of the swimming performance of several species of fish from the Mackenzie River. Journal Fisheries Research Board of Canada 31:1641-1647.
☐	Khoroshko, P.N. 1972. The amount of water in the Volga basin and its effect on the reproduction of sturgeon (Acipenseridae) under conditions of normal and regulated discharge. Journal of Ichthyology 12:608-616.
☐	McCabe, G.T. and L.G. Beckman. 1990. Use of an artificial substrate to collect white sturgeon eggs. California Fish and Game 76(4):248-250.
☐	McPhail, J.D. 1997. A review of burbot (Lota lota) life history and habitat use in relation to compensation and improvement opportunities. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2397. Department of Fisheries and Oceans. Canada.
☐	Nilo, P., Dumont, P., and Furtin, R. 1997. Climatic and hydrological determinants of year-class strength of St. Lawrence River lake sturgeon (Acipenser fulvescens). Canadian Journal of Aquatic Science 54:774-780.
☐	Northcote, T.C. 1973. Some impacts of man on Kootenay Lake and its salmonids. Great Lakes Fishery Commission, Technical Report Number 2, Ann Arbor, Michigan.
☐	Paragamian, V.L. 1993. Kootenai River fisheries inventory: stock status and rainbow trout and fisheries inventory. Idaho Department of Fish and Game. Bonneville Power Administration, Annual Progress Report, Project 88-65, Boise.
☐	Paragamian, V.L. 1994. Kootenai River fisheries inventory: stock status and rainbow trout and fisheries inventory. Idaho Department of Fish and Game. Bonneville Power Administration. Annual Progress Report, Project 88-65. Boise.
☐	Paragamian, V.L. 1995. Kootenai River fisheries inventory: stock status and rainbow trout and fisheries inventory. Idaho Department of Fish and Game. Bonneville Power Administration. Annual Progress Report, Project 88-65. Boise.

☐	Paragamian V., G. Kruse and V.D. Wakkinen. 1995. Kootenai River white sturgeon investigations. Idaho Department of Fish and Game. Prepared for Bonneville Power Administration. Annual Progress Report, Project 88-65, Portland, Oregon.
☐	Paragamian, V., G. Kruse, and V.D. Wakkinen. 1996. Kootenai River white sturgeon investigations. Idaho Department of Fish and Game. Prepared for Bonneville Power Administration. Annual Progress Report, Project 88-65, Portland, Oregon
☐	Paragamian, V., G. Kruse, and V.D. Wakkinen. 1997. Kootenai River white sturgeon investigations. Idaho Department of Fish and Game. Prepared for Bonneville Power Administration. Annual Progress Report, Project 88-65, Portland, Oregon.
☐	Paragamian, V., G. Kruse, and V.D. Wakkinen. 1998. Kootenai River white sturgeon investigations. Idaho Department of Fish and Game. Prepared for Bonneville Power Administration. Annual Progress Report, Project 88-65, Portland, Oregon.
☐	Paragamian, V., M. Powell, and J. Faler. In press. Mitochondrial DNA analysis of burbot Lota lota stocks in the Kootenai Basin of, British Columbia, Montana, and Idaho. Transactions of the American Fisheries Society.
☐	Parsley, M. 1991. How water velocities may limit white sturgeon spawning. Research Information Bulletin, U.S. Department of the Interior, U.S. Fish and Wildlife Service, 91-86.
☐	Parsley, M.J. and L.G. Beckman. 1994. White sturgeon spawning and rearing habitat in the lower Columbia River. North American Journal of Fisheries Management 14:812-827.
☐	Partridge, F. 1983. Kootenai River fisheries investigations. Idaho Department of Fish and Game. Job Completion Report, Project F-73-R-5, Boise.
☐	Sambrook, J.E, E.F. Fitch, and T. Maniatis. 1989. Molecular Cloning: a laboratory manual. Cold Spring Harbor Press, Cold Spring Harbor.
☐	Snyder, E.B. and G.W. Minshall. 1996. Ecosystem metabolism and nutrient dynamics in the Kootenai River in relation to impoundment and flow enhancement for fisheries management. Stream Ecology Center, Idaho State University, Pocatello, Idaho.
☐	Votinov, N.P. and V.P. Kas'yanov. 1978. The ecology and reproductive efficiency of the Siberian sturgeon, Acipenser baeri, in the Ob as affected by hydraulic engineering works. Journal of Ichthyology 18:20-28.

PART II - NARRATIVE

Section 7. Abstract

The Kootenai River has undergone many physical changes. The most recent changes are due to operation of Libby Dam for hydropower and flood control. The operation of this dam and it's impoundment have altered the river ecosystem by reversing the hydrograph, the river is warmer during winter, and the reservoir is a nutrient trap. Results have been; reduced productivity of the river, an altered fish community (more omnivores), inadequate recruitment of white sturgeon (ESA listed), collapse of the burbot fisheries, a reduction in the quality of rainbow trout fishing, and lower recruitment of bull trout. Many resident species and were listed as species of special interest in the 1994 Columbia Basin Fish & Wildlife Program. Our main goal is the restoration of the ecosystem and these important fisheries through designed research, flow experiments, and monitoring target fish populations and environmental variables. The USACE provides mitigative flows for spawning and rearing of Kootenai River white sturgeon and research efforts have shown sturgeon responded to improved springtime flows. Numerous eggs have been collected and several juvenile white sturgeon hatched during mitigative flow years were captured. It will take a minimum of one generation (20 years) to restore the white sturgeon. The burbot population is imperiled. Only one tributary is known to support burbot spawning and it is in B.C.. The burbot stock in Idaho is genetically distinct from fish further upstream in Montana. Research information indicates burbot spawning migrations may be impeded by high winter water velocities created during hydropower production and floodwater evacuation. Also, warmer winter water temperature may be disrupting spawning synchrony of burbot. Salmonid studies are focused on early life history and movement of adults. The source of bull trout recruitment is unknown. Rainbow trout are the most popular sportfish but few juvenile trout are found in the river. Research efforts indicate rainbows spawning in the Deep Creek drainage are adfluvial but the source of recruitment for the river above Bonners Ferry is poorly understood. Although surveys indicate tributaries may be fully seeded, reduced productivity may be limiting juvenile trout survival once they reach the Kootenai River from nursery tributaries.

Section 8. Project description

a. Technical and/or scientific background

The Kootenai River has undergone many adverse anthropogenic changes in the last century. The most recent of which was the construction and operation of Libby Dam. Operation of Libby Dam and the impoundment (Lake Koocanusa) changed the river hydrograph, water temperatures and nutrient cycling of the river. Many native species were affected by the dam including white sturgeon, burbot, redband rainbow, cutthroat, and bull trout, mountain whitefish, and kokanee. All of these species have been cited as important resident fish in the 1994 Fish and Wildlife Program. These changes also impacted Canadian waters, primarily the Kootenay Lake fish community and productivity of the lake.

The Kootenai River white sturgeon is an Endangered Species. It once provided a popular sport fishery for Native Americans, residents, and tourists. Since construction of Libby Dam recruitment has been extremely limited (Partridge 1983 and Apperson and Anders 1991). The reversal of the Kootenai River hydrograph from high flows in spring (predam) to low flows during the spring spawning season is thought to be the main reason for the loss of recruitment. Flows appear to be the most limiting factors to sturgeon, growth, reproduction, and egg and larval survival. Other investigators of sturgeon populations have cited the importance of high spring flows for adequate sturgeon recruitment (Alekerperov 1966, Khoroshko 1972, Votinov and Kas'yanov 1978, Parsley 1991, Parsley and Beckman 1994, Auer 1996, and Nilo et al. 1997). Since listing of the Kootenai River white sturgeon the USACE has provided experimental water management in the form of increased springtime flows to provid improved spawning conditions for sturgeon. White sturgeon movement and spawning has been monitored with telemetry gear during these flows (Paragamian et al. 1995, 1996, and 1997). Spawning of white sturgeon is documented by deploying sampling mats (McCabe and Beckman 1990) and the eggs are staged (Wang et al. 1985) to determine spawn date in relation to flow. As a result of improved spawning conditions many white sturgeon eggs have been collected since 1994 (Paragamian et al. 1995, 1996, 1997,and 1998). However habitat suitability curves have shown Kootenai River white sturgeon may have different spawning needs than other sturgeon (Parsley and Beckman 1994). Our research efforts have shown Kootenai River white sturgeon spawn at cooler temperatures, slower moving water, over sand substrate but spawn at depths similar to Columbia River sturgeon. Recruitment of some wild juvenile sturgeon from flow test years has shown optimism for the prospects of recovery (Paragamian et al. 1995, 1996, 1997,and 1998).

Burbot once provided a popular winter sport and commercial fishery for Native Americans, residents and tourists in north Idaho. It was also important as a sportfish to the many anglers that fished Kootenay Lake in British Columbia (Paragamian 1994). In Idaho the burbot is endemic only to the Kootenai River. Little information is available on the management and biology of burbot but it seems to be a common phenomenon in the Pacific northwest that burbot populations collapse below dams but may flourish above them (McPhail 1997). Within one generation of construction of Libby Dam the population was on the verge of collapse (Paragamian 1994) and burbot are now closed to fishing. Burbot densities in Idaho are extremely low and the population is imperiled (Paragamian 1994, 1995, and 1996). Mt DNA analysis (Sambrook et al. 1989 and Dowling 1990) of Burbot in the Kootenai River in Idaho and B.C. indicated they are genetically distinct from burbot in Montana (Paragamian et al. in press). Although burbot are common in Lake Koocanusa the genetic evidence indicates the reservoir is not a source of recruitment to the population in Idaho. The only remaining spawning is located in the Goat River, B.C. Burbot are weak swimmers (Jones et al. 1974) and preliminary information indicates high velocities, created during power production/flood, may be inhibiting these winter spawning fish from reaching traditional spawning tributaries in Idaho (Paragamian 1995) or causing stress a related factor that reduces spawning fitness. In addition burbot spawn during very cold conditions (Becker 1990) and since the river is now warmer in the winter their spawning synchrony may be

disrupted. Our study has focused on sonic tracking of burbot during varying winter flow conditions and before and after test periods of minimum flow. The objective is to determine how burbot respond to these varying flow conditions and to determine how Libby Dam can be managed to produce hydropower and evacuate floodwater but allow periods for burbot spawning migrations. In addition we have maintained temperature profiles of the Kootenai River and tributaries to examine the prospect that post dam temperature changes could have altered the spawning of burbot. There may be other factors impacting burbot but at this time they are unknown.

As previously mentioned the Kootenai River ecosystem has been seriously disrupted . Other factors such as loss of nutrients because of Libby Dam (Northcoat 1973, Bonde and Bush 1975, and Snyder and Minshall 1996) has also seriously affected primary and secondary productivity. As a result the alteration of food webs has changed the species composition of the fish community from the years immediately after the dam (Partridge 1983) to more recent times (Paragamian 1995). The system now harbors a greater biomass of omnivores vs. insectivores like trout and mountain whitefish (Paragamian 1995). A recent creel census (Paragamian 1995) indicated rainbow trout is the most popular sport fish in the Kootenai River but the harvest is much lower than that of other rivers in Idaho. Preliminary information indicates the nursery tributary streams are well seeded (Paragamian 1994) but in river inventories indicate low numbers of trout and very poor recruitment of young fish (Paragamian 1994 and 1995). Whitefish are the most abundant sportfish in the Kootenai River in Idaho. Whitefish densities, recruitment of young, and growth rate is lower than pre Libby days. At present our studies are designed to determine the main sources of rainbow and bull trout recruitment and determine some of the limiting factors to recruitment. Recent returns of tags from trout marked in Idaho in 1997 and 1998 and creeled in Kootenay Lake (Downs, unpublished findings) suggests these fish may be an adfluvial stock. Few were creeled in Idaho. At this time we believe trout in the lower river in Idaho are recruits from the Deep Creek drainage but fish in the upper river may be from Montana rearing areas, tributaries in Idaho, or both.

To better understand the Kootenai River ecosystem and its biological interactions the IDFG and the KTOI has committed to using the Adaptive Ecosystem Assessment process. Workshops have been held and carried to completion. In addition a user guide for the AEA model for the Kootenai River is in preparation. Eventually we believe the AEA process will guide us to methods of improving productivity, survival, recovery, and growth of fish in the Kootenai River.

b. Rationale and significance to Regional Programs

The Kootenai River Fisheries Investigations (KRFRI) compliments the five year plan for the Panhandle Region of IDFG. Within the Regional Five Year Plan are the goals to recover the endangered Kootenai River white sturgeon and the burbot. Our rationale is based on development of sound data bases and testable hypothesis. However, it should be noted that it would also be important for numerous Federal Agencies to

cooperate in these efforts. The KRFRI is also important to fish managers of the province of British Columbia. The primary species in this investigation are all transboudary and any research findings and recommendations are also important to our Canadian colleagues. The KRFRI is a program within itself with numerous goals and several testable hypotheses. The project objectives were previously listed while the investigation Goal: Restore sportfish populations in the Kootenai River to self-sustaining levels capable of supporting an improved sport fishery by the year 2018. Sub goals are – White sturgeon Goal: Recover the Kootenai River white sturgeon population to a self-sustaining level and delisting status within one generation(2018). Burbot investigation Goal: Develop a recovery plan for Kootenai River burbot by the year 2000. Salmonid investigation Goal: By the year 2004 provide a management plan to improve the rainbow fishery in the Kootenai River and management needs to recover bull trout. Hypothesis have been developed for white sturgeon- (1) Augmented discharge from Libby Dam will stimulate white sturgeon migration and spawning, and enhance survival of eggs and larval sturgeon. Burbot – (2) Minimum winter flows will allow burbot migration to spawning tributaries in Idaho and reduce stress. Rainbow trout and salmonid studies are still in the developmental stage. As these studies progress we expect new information to be of value in formulating sound testable hypothesis and eventual recovery plans. As mentioned in another section of this document, many of the objectives of the KRFRI are listed as measures in the Kootenai River White Sturgeon Recovery Plan and the state of Idaho Bull Trout Recovery Plan (draft), is also based on NMFS Biological Opinion, and the NWPPC charge to restore native fishes that were adversely affected by hydropower and flood control development. It is also our intention to assist the KTOI in achieving their goals in the cooperative effort to improve the Kootenai River ecosystem recover Kootenai River white sturgeon (the primary charge of the KTOI is the short term goal to prevent extinction of white sturgeon by stocking hatchery fish), and other fish species. At present the KRFRI has the most complete long term data base on white sturgeon and the most complete data base on year around telemetry. In addition the burbot investigations are unique and have compiled the most detailed behavioral data on record. If this investigation is not funded recovery of these important fisheries and the ecosystem will be lost for eternity.

c. Relationships to other projects

The Kootenai River Fisheries Recovery Investigation is comprised of several companion studies with inter agency cooperation with other related studies. The KRFRI has targeted white sturgeon (ESA listed), burbot, whitefish, and rainbow and bull trout in the Kootenai River and tributaries to determine factors limiting these depressed populations and improving habitat. Tasks outlined in the KRFRI Work Plan also include assisting the Kootenai Tribe of Idaho with brood fish collections, Monitoring and Evaluation of wild sturgeon spawning and rearing, evaluation of hatchery stockings of sturgeon from the tribal hatchery including contribution to the total population, intraspecific competition with wild juveniles, condition, and food habits of juvenile hatchery white sturgeon. In addition is the Monitoring and Evaluation (M&E) of flows provided by the US Army Corps of Engineers for sturgeon spawning and rearing. M&E is a cooperative study by IDFG, Kootenai Tribe of Idaho, and the Montana Department of Fish Wildlife and Parks.

The AEA process is also a cooperative effort between IDFG and the Kootenai Tribe of Idaho. AEA will be used to examine the prospects of adding nutrients to the Kootenai River to improve primary and secondary productivity to enhance fish growth and survival. In addition we work cooperatively with the British Columbia Minnistry of Environment (BCME) subcontract through our study. We now know white sturgeon, burbot, and rainbow trout are transboudary populations. Study with BCME includes larval tows for white sturgeon and burbot in Kootenay Lake, adult white sturgeon sampling, sonic and radio telemetry for burbot, sturgeon, rainbow and bull trout; hoopnet sampling for burbot, and angler tag returns from rainbow trout tagged in Idaho and creeled in Kootenay Lake.

d. Project history (for ongoing projects)

Historically the Kootenai River has been an important river to the settling and development of north Idaho. It also provided important fisheries to both Native Americans and other residents of north Idaho. Within five years of the operation of Libby Dam the IDFG began an investigation to inventory the fish community and sportfish populations (Partridge 1983). The study also included an investigation to determine the status of white sturgeon and burbot. The burbot population and fisheries were found to be on the decline and the white sturgeon population was comprised primarily of adult fish, few juvenile fish had recruited to the fishery since Libby Dam. The Kootenai River Fisheries Recovery Investigations (Project 88-65) began September 1, 1988 and was a follow up study to help formulate a management plan to recover the fisheries. The project includes the study of white sturgeon and burbot/whitefish/rainbow and bull trout in the Kootenai River downriver of Libby Dam. Through a cooperative effort, the Idaho Department of Fish and Game and the Kootenai Tribe of Idaho completed an assessment of the status of white sturgeon in the Kootenai River, successfully cultured sturgeon from the endemic stock, and stocked age 1 and age 2 sturgeon into the Kootenai River (Apperson 1990; Apperson and Anders 1991 and 1992). Recruitment of wild sturgeon to the Kootenai population has been very limited since Libby began operation in 1972. Regulated flow from the dam has been identified as the primary factor limiting sturgeon spawning and early rearing. On June 11, 1992, this population was petitioned for protection under the Endangered Species Act and listed as endangered by the USFWS on October 6, 1994. The first experimental spawning flows occurred May-June 1991. Since 1994 experimental flows have been provided each year. Declines observed in populations of burbot, kokanee, whitefish, cutthroat, rainbow and bull trout, and Gerrard rainbow trout have been attributed to regulated flows from Libby Dam warmer winter temperature and entrapment of nutrients within the reservoir. Research work continues to recover the endangered Kootenai River white sturgeon, and develop management plans to recover burbot, restore rainbow trout fishing, restore bull trout, and restore the ecosystem.

e. Proposal objectives

FY 2000: (1) Hypothesis: Flows post Libby Dam have effected growth and vital statistics of Kootenai River white sturgeon Product - Changes in growth or condition in

white sturgeon may be a contributing factor to reduced spawning fitness or changes in age at maturity. (2) Hypothesis: Flows simulating pre dam conditions will improve survival and recruitment of white sturgeon. Determine the minimum flow that will provide spawning and rearing habitat in the Kootenai River. Product - The Kootenai River can be managed during the spawning season to optimum benefits for recovery of white sturgeon and flood control. Two manuscripts are in progress for publication 1; A model predicting white sturgeon spawning migration and 2; Micro habitat criteria for Kootenai River white sturgeon spawning. (3) Hypothesis: Food is a factor limiting survival of young sturgeon and stockings of hatchery fish impair survival of wild sturgeon. Product – Appropriate stocking numbers of white sturgeon can be identified based on survival and presence of intraspecific competion between wild and hatchery fish for food (assuming food is in short supply and growth and condition of hatchery and wild is less than to be expected). (4) Hypothesis: Varying flows and/or nutrient losses in the Kootenai River effect survival and growth of juvenile sturgeon. Product - Varying flows because of power peaking or flood control could effect growth of juvenile sturgeon (reduced productivity of varial zone). Water management recommendations would be provided to improve growth and survival. Reduced productivity in the Kootenai River could have reduced carrying capacity for juvenile sturgeon and this data can be used as baseline information for nutrient studies with KTOI. (5) Hypothesis: High velocities created during power production and flood control operations of Libby Dam impede or prevent burbot from reaching spawning tributaries. Product – Winter water management could be modified to provide lower flows for burbot migration. Distance traveled by burbot under various flows can be determined to determine length of time necessary for travel to traditional spawning areas. (6) Identify methods to effectively sample larval burbot and white sturgeon, time of year, and locations to sample. Product - A systematic sampling scheme based on gear, location, and chronology will be devised that will effectively measure year class success of burbot or sturgeon based on abundance of fish at age 0. (7) Identify the genetic and behavioral similarity of Duncan burbot as a donor stock of burbot. Product – Flow management alone in all likely-hood will not recover burbot but a donor stock may be vitally helpful to rebuilding the stock to reestablish runs to historic tributaries. (8) Identify factors limiting rainbow and bull trout survival and or recruitment in the Kootenai River (this study is in the developmental stage). Product – Results from this investigation will provide data needed to formulate management recommendations and formulate hypotheses to test. Identification of sources of recruitment for rainbow and bull trout will pinpoint management or research locations. Analysis of genetic makeup and behavior (adfluvial/fluvial) will provide direction for management and research needs. (9) Hypothesis: Heavy metals or other toxicants are in lethal or sublethal concentrations in sturgeon eggs and effect survival. Product – Source of possible toxicant uptake will be identified and recommendations to reduce risks to sturgeon ova and larva can be made. This information may even have a bearing on the KTOI Conservation Culture Programs future eg. Continue program beyond recommended 10 years. (10) Hypothesis: Donor stocks of burbot will provide a viable means of restoring burbot in Kootenai River Product – If there is a fidelity for spawning tributaries, burbot progeny will return to spawn and help restore the burbot fishery (providing habitat conditions are also restored). (11) Hypothesis: High flow conditions in Autumn and winter are stressful to burbot raising blood cortisol levels, reducing

spawning fitness, stamina, and impairng vitellogenin synthesis to eggs. Product – Critical velocities will be determined and equated to flow management and in river conditions during the spawning season, thus, flow management recommendations can be provided that are not stressful to burbot. These data can augment information obtained from telemetry results.

f. Methods

White sturgeon studies; capture adult white sturgeon w/set lines (up to 50) white sturgeon respond to augmented flow - telemetry of 30-50 adult sturgeon (sonic and radio), documentation of sturgeon spawning by deploying 80 egg mats at various locations. Sample larval sturgeon with shrimp trawl, benthic trawl, D- rings, meter nets or midwater trawl, sample up to 50 juvenile sturgeon w/small mesh gill nets and sacrifice 25 hatchery juveniles for food habit analysis to determine if food is a limiting factor. Sample reproductive tissues to determine if toxic substance residues are limiting egg survival. Burbot studies; sample burbot w/baited hoop nets in lower river, implant sonic transmitters. Use Fisher Exact Test and Chi-square to determine affect of power production/flood control on burbot migration. Sample burbot eggs with drift nets to verify burbot spawning and locations. Record river and tributary temperatures with continuous recording thermographs. Use temperature data to determine relation to burbot spawning synchrony. Under laboratory conditions test burbot with varying flow velocities to determine if and at what level velocities may effect blood cortisol and burbot spawning fitness or vitellogenesis. Assess the prospects of restoring runs of burbot to historic spawning tributaries with a captive donor stock of burbot. Rainbow and bull trout, sample adults and juveniles with backpack electroshocker, use ANOVA to determine differences in outmigrants from upriver tributaries, sample with screw trap. Tag adult rainbow trout with Floy reward tags to determine minimum exploitation rate and movement. Surgically implant radio transmitters in 20 adult rainbow and 4 bull trout to monitor movements and determine spawning and rearing locations. Use the AEA process to formulate long range management plan to improve growth, productivity, and survival of target fish.

g. Facilities and equipment

The majority of office work is centered out of the Idaho Department of Fish and Game Panhandle Region office in Coeur d Alene. There are five desktop computers and one laptop computer that belong to the project. There is access to computer printers, a fax machine, a Xerox machine and other necessary office supplies. We have an extensive library collection for information pertaining to sturgeon, burbot and trout and can access any information through the Idaho State Library. Field operations are centered at our field station, located at the Kootenai River National Wildlife Refuge in Bonners Ferry. The field station consists of a 3-bedroom modular home with residence and minimal office facilities. There is a fax machine, desk and office supplies. There is presently a portable 30 foot storage shed, used to store one boat and other non-sensitive equipment. All sensitive equipment is stored inside the modular home.

This project operates with 6 boats (14' Mirrocraft, 16' Valco, 16' Boston Whaler and a 21' Almar with outboard propeller-driven motors, a 16' Wooldridge with an outboard jet motor and a 21' Customweld inboard jet). All boats are equipped with paddles, tools, life vests or cushions, boat hook, whistle or horn, fire extinguisher, anchor and rope, cigarette lighter port and a first aid kit. Coast guard certified anti-exposure suits and jackets are also available. We have use of four 4wd and one 2wd trucks. One truck is equipped with a snowplow and a winch. All trucks contain a fire extinguisher, tools, snow chains and other safety devices.

The work that pertains to sturgeon includes sampling for white sturgeon eggs, larvae and juveniles during the spring spawning season. We capture adult white sturgeon and attach radio and sonic tags for tracking with telemetry equipment.

Equipment used for collecting eggs includes: 1 boat; an ammo box stocked with sample vials, labels, hand-held thermometer, pens, markers, extra bolts and nuts for repairing the eggmats, pliers, screwdriver and formalin to preserve eggs; data sheets; map of the river; Eagle depth sounder with spare rechargeable batteries and a pelican case for storage; General Oceanics digital flow meter with 100' of cable, lead weight with a fin, rope and pelican case for storage; buoys; 3.5'x4' angle iron eggmats fitted with furnace filter material; experimental eggmat drift nets; anchors for eggmats; rope and gloves; Magellan GPS unit to locate set sites for eggmats. A microscope is used to determine developmental stages of eggs.

Equipment used for sampling larval and young-of-the-year sturgeon includes: 1 outboard motor boat; 16'x7.5' benthic trawl, two half-meter nets and one meter net; weights to hold half-meter nets in the water column; diver depth gauges attached to nets to determine exact depth of tow; ammo box equipped with sample vials and labels, pencils, markers and formalin to fix samples; Eagle depth sounder with spare rechargeable batteries and pelican storage case; boom winches on boat to run nets from; rope; timer to time tows; data sheets; river map.

Equipment used for juvenile white sturgeon sampling includes: 1 boat; 5-6 gillnets with 1.5-2" multifilament mesh; weights, rope and bouys for use with nets; surgery kit stocked with sonic tags, downrigger wire and crimps for attaching sonic tags, Passive Integrated Transponder (PIT) tags, envelopes for collecting fin rays, hacksaw to remove fin ray, measuring tape, sample vials and labels, knife, pens and markers; hard copy of the sturgeon database; data sheets; river map; hand-held thermometer; sonic and radio tag receivers and antennae and pelican storage cases; PIT tag reader and pelican storage case; scale for weighing fish; stretcher to hold fish in water while recording data; Bottomline Fishing Buddy depth sounder with spare rechargeable batteries and pelican storage case; plastic tub; formalin for fixing samples; weight scale.

Equipment for telemetry tracking of tagged adult and juvenile sturgeon includes: 1 boat; two Sonotronics USR-91 narrow band sonic receivers equipped with a DH-2 directional hydrophone and earphones and rechargeable batteries; pelican storage cases; two model R2100 ATS, 30-32 MHz radio receivers equipped with a loop antennae; two

stationary ATS model RRT2000 stationary radio receivers for 30-32 MHz tags, model DRT5040 data loggers and yagi antennas; ATS model TSA2000, 30-32 MHz external attachment radio tags; 50-month CT-82-3 external attachment sonic tags; data sheets; river map; pencils. We also use a DPL-275A diver-operated sonic receiver for retrieving shed sonic tags from the river bottom.

Equipment used to capture adult white sturgeon includes: 1 boat; rope, bouys, anchors, 12,14&16/O circle hooks and bait; rod and reels with 6/0 hooks; surgery kit containing sutures, scalpel blades, forceps, needles, tape measure, knife, hacksaw and blades to remove fin rays; sample vials and labels; markers and pencils; nitrifurizone antibiotic, alcohol, otoscope, PIT tags and injector, taigon tubing, digital scale, sonic and radio tags, downrigger wire and crimps to attach sonic and radio tags, pliers, envelopes for fin rays; cooler to store egg samples; buckets; stretcher to hold fish in water while recording data; bilge pump to pump water over fishes' gills during surgery; weight scale; PIT tag detectors and pelican storage case; Eagle depth sounder and pelican storage case; hand-held thermometer; data sheets; river map; hard copy of the sturgeon database; sonic and radio telemetry receivers, antennae and hydrophone and pelican storage case; winch. A dremmel tool, slides, mounting media and a microscope are used to determine age of sturgeon with fin rays.

Miscellaneous tools and equipment include: portable thermographs, drill, skill saw, wrenches, screwdrivers, hammers etc.; materials for boat and vehicle repairs; battery charger; portable honda pump. SCUBA equipment is used for visual surveys and to retrieve shed sonic and radio tags as well as stuck nets and mats. A minolta 35mm camera is available to photograph significant events.

Some of the above equipment and the following equipment is used for burbot and trout studies: Hoopnets; backpack and boat electroshocker, screw trap, snorkel equipment, floy tags, 14-month sonic tags, 3-month radio tags, drift nets, dip nets, beach seine and measuring board.

h. Budget

The Kootenai River Fisheries Investigation has been a maintenance budget for the last five years and no enhancements are expected. The only exception is inflationary increases. Personnel costs are kept to a minimum by using temporary help and sharing the work force within the project. Fringe benefits are normal benefits available to all state employees. Supplies and non-expendable costs are kept to a minimum by sharing within the project and with cooperating agencies also funded by BPA. Operation and maintenance is also shared within the project completing several tasks within one field team. Capital improvements are limited to replacement items and on some occasion's technical improvements. Travel is limited to professional meetings that will have relevance to the studies, out of state travel is highly scrutinized by Boise Administrators. Sub contracts have improved efficiency by contracting certain technical tasks to professional specialists, thus, saving time and equipment rental or purchases.

Section 9. Key personnel

Vaughn L. Paragamian – Senior Fisheries Research Biologist and Program Leader
Full time FTE

Chris Downs – Fisheries Research Biologist – Full time FTE

Gretchen Kruse – Senior Fisheries Technician – Full time FTE

Vint Whitman – Senior Fisheries Technician – Full time FTE

Section 10. Information/technology transfer

Information and technology resulting from these studies will be transferred by a variety of oral and written methods of communication. Some of these communication methods will be coordinated with the IDFG Administrative staff, Information and Education Specialist, local media professionals, and professional society officers. Oral communication includes weekly staff meetings, conference calls, phone conversation, technical oral reports, radio and television programs, and presentations to sport and service clubs; State, Divisional and National American Fisheries Society Conferences; Professional symposia (International Burbot Symposium 1998 and Paddlefish and Sturgeon Symposium 1996); Kootenai River White Sturgeon Recovery Team and the Kootenai River Burbot Recovery Committee; and workshops like the Columbia Basin and BPA funded program meetings. Written communication methods include memos, Quarterly Reports, Annual Reports, Completion Reports, and news releases. Specific aspects of our studies will be published in peer reviewed symposium proceedings and scientific journals. All of these methods have already been used in disseminating information from the Kootenai River Fisheries Investigations. At the present time one ms. Has been accepted by the Transactions of the American Fisheries Society , two will appear in the Proceedings of the International Burbot Symposium, and three ms. are in preparation for journal consideration.

Congratulations!